ENGINEERING EDUCATION

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Society for the Promotion of Engineering Education

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PROGRAM OF THE BOARD OF INVESTIGATION AND COORDINATION.

BY W. E. WICKENDEN,

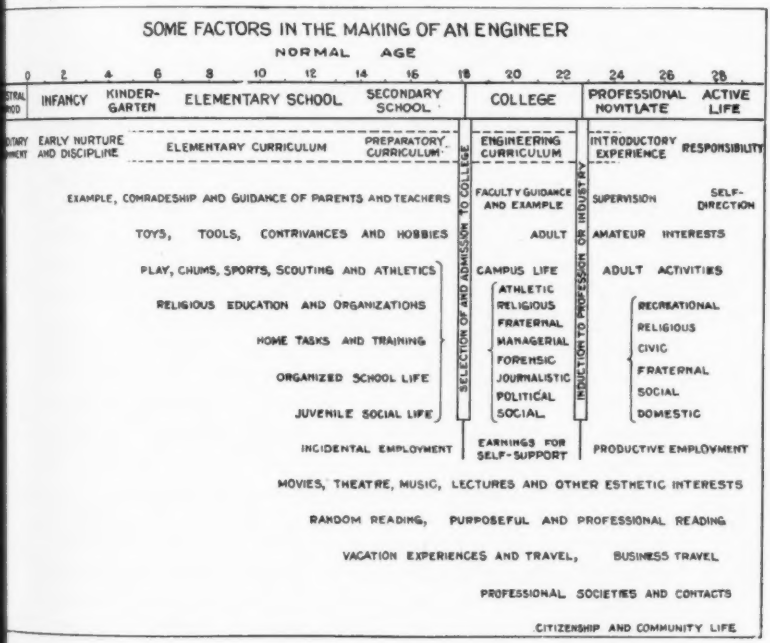
Director of Investigations.

The events which led up to the establishment of the Board of Investigation and Coördination and to its undertaking a comprehensive project of inquiry and development have been fully recounted in the discussions and publications of the Society. In constituting this Board the Society directed that "there shall be organized and conducted (*a*) an active campaign for the promotion of engineering education in the light of the needs of the future as these needs may be developed; (*b*) there shall be coördinated as far as possible the activities of the various agencies interested in promoting engineering education; and (*c*) there shall be conducted research in engineering education."

The above statements are in effect the charter under which the Board is operating. While the Board's field of activity is potentially a very broad one, the terms of the grant made by the Carnegie Corporation are more explicit. At another time and under other circumstances the Board may enter upon other projects of inquiry or promotion, but for the present it is engaged upon "a study of the objects of engineering education and the fitness of the present-day curriculum for preparing the student for his profession" and in relating to that study others now in progress, with the aim of indicating "such modifications or developments as would seem to make for a sound, well-balanced and fruitful course of study for engineering students."

Education as a process of "drawing out" has to do primarily with individuals. One does not "draw out" men in groups or masses. The projects of engineering education are not mere abstractions and the engineering curriculum is no

mere process formula. These things have to do with individual human beings and can be seen in true perspective only as elements of a vastly complicated process of unfolding of body, mind and personality. When confronted by human problems of such variety and complexity we have an inherent tendency to simplify the situation by dealing with types. How far can we trust to types in dealing with this problem?



The above chart is intended to be suggestive rather than inclusive or accurate in details, and it indicates the wide range and variety of influences, hereditary, environmental and educational, involved in the making of an engineer. The horizontal scale is approximately chronological and is divided into

periods which are indicated by the principal stages of schooling and experience.

The successive curricula of the schools are enclosed between broken lines, suggestive of continuity and definiteness of organization with some degree of flexibility. These broken lines fade out at the ends, since the transition to and from formal training is usually not abrupt. The lines extend beyond the stage of induction to professional or industrial life to indicate the semi-formal introductory training given many engineering graduates.

In general, the individual and social influences at work on the student are arranged in groups according to sequence. Pre-college life shows an increasing degree of complexity in the secondary school period. College life begins and ends in two highly critical experiences, the first involving the choice of a college and of a field of study by the student and the choice of the student by the college, and the second a choice of initial employment by the graduate and the choice of the graduate by the employer. Both of these critical experiences usually lead to a radical change of environment, economic status, guidance, work content, work habits, and organization of personal and social life. Each is followed by a relatively unstable period in which errors of choice are revealed and the inevitable readjustments are made, often by a method of trial and error.

The abrupt change which follows graduation often throws the young man into circumstances which are very precarious to the habits of study and reflection on which the continuance of educational effort depends. It seems to be quite generally agreed that an engineering education can not be completed in college. In fact engineering progress is so rapid and continuous that the engineer must be a life-long student, in other words an effective self-educator. These considerations suggest that the college might appropriately extend its guidance in some degree to the early years after graduation.

The engineering curriculum and the related methods of teaching are subject to certain bounding conditions which

need to be carefully surveyed before any changes or reorganization are proposed.

1. It is self-evident that the engineering curriculum depends upon the characteristics of the engineering student. What sorts of boys ought to be attracted or directed to engineering colleges and how can the colleges exercise a constructive control over the factors which shape the student before he reaches college? Can we find ways to get the right sorts of students into engineering colleges and not merely keep the wrong sorts out? Are engineering students—either the actual ones we have or the ideal one we desire—sufficiently of a type to enable us to discover what processes of thinking and learning are natural to them and what alien to a degree? What training and experience may we reasonably insist upon in advance of engineering training?

2. It is equally self-evident that the engineering curriculm depends upon what the engineer is and upon the circumstances which surround his professional work. It also depends upon what evolution and conscious choice are tending to make of the engineer. Here again we encounter the problem of types. Is there a type or a series of types, however few or many, by which we can picture or describe the engineer of the present or the future as a guide to our educational effort? Can the extent of the professional demand be foretold with fair certainty?

3. Another bounding condition on which the curriculum depends is the critical period of transition which lies between college life and the active and responsible years of maturity and is indicated on the chart as the "professional novitiate." What concern has the college with the placement processes by which its graduates are initially distributed? What training and equipment is needed to meet the problems characteristic of this period? What part of the more specialized training may safely be left to this period? Has the college a function of guidance and stimulation to perform which extends into this period?

4. Another bounding condition determining the curriculum

relates to the resources and limitations of the colleges themselves. How far do the size, economic environment, method of financial support, and proximity of other institutions determine the degree of diversification and specialization appropriate for any institution? What are the educational processes essential for various fields of engineering which can not be carried out effectively or economically on college premises and which must be worked out jointly with industrial or professional organizations? How fully can hampering limitations, both economic and professional, which surround the engineering teacher be overcome or relieved?

It is the belief of the Board that the first year of the present project can best be devoted to a study of these bounding conditions. The Board must also give its active attention to the development of its coöperative relations with the representatives of the engineering professional societies, the industries, other educational organizations, social welfare agencies and the U. S. Bureau of Education.

The Board is therefore proposing:

1. That the several engineering colleges appoint local committees of investigation to coöperate with the Board by undertaking studies according to local interest and the resources available, which lie within the following general area:

a. The cultural, industrial, educational, economic and ancestral background of engineering students.

b. The circumstances and conditions attending the admission and early adjustment of students.

c. Extra-curricular activities of engineering students with reference to their educational value and their interference with normal college functions.

d. The personal and professional qualification of their teaching staffs.

e. The distribution and circumstances surrounding their graduates during their first two years out of college.

f. The distribution and records of alumni of more than two years standing.

g. Opinions from alumni on elements of value in engineer-

ing education, the proper course of future development, the upbuilding of the teaching staff and the attraction of well qualified students.

2. That the several investigative committees of the Society undertake studies with the coöperation of the Director and the local investigative committees of the colleges as follows:

a. Committees on professional subjects, *e.g.*, civil engineering, correlation studies based on data supplied by local committees on the distribution of graduates of the several engineering courses and the circumstances surrounding their work in the early years after graduation, with special reference to the degree of specialization or specific training needed as preparation for early duties, the practicability of fostering further educational effort in this period and the propriety of granting professional degrees without required study or post-graduate work in residence.

b. Committees on related sciences and English, a study of the means by which the needs of exceptional students—both the able and the slow or inept—may be met in these subjects, also the extent to which students of unusual ability are permitted to elect advanced work in these subjects as a substitute for courses in engineering practice.

c. Committee on admission and freshman, correlation studies based on data supplied by local committees on the grounds and information on which engineering students choose their respective colleges and courses of study; the present state of vocational information and guidance with reference to engineering; and the present state of the problem of determining the degree of aptitude for engineering study and its bearings on standards of admission, elimination and early adjustment.

3. That the advisory council of the national engineering societies consider what are the standards and objectives in engineering education which are of concern to the profession at large and undertake to formulate its recommedations for the guidance of educational effort. Within this field it may wish to consider:

a. The minimum standards which the profession at large

may properly set for the recognition of any institution as a college of engineering, or any course of study as an engineering course.

b. The common ground work of general studies which should underlie the professional training of all engineers.

c. The common ground work of technological studies which should be included in the training of all engineers.

d. The extent to which specialization is desirable and the stage at which it should begin.

e. What the profession at large should contribute to the field of vocational information and guidance.

f. The desirable or necessary qualifications of engineering teachers.

g. The economic and professional status of engineering teachers.

h. Means which should be taken to impress on egineering students the nature and ethics of professional obligations.

i. The extent to which the contacts of professional societies with student groups should be unified or coördinated.

4. That the joint advisory committee of the National Industrial Conference Board and this Society should continue its study of the nature and magnitude of the industrial demand for engineering graduates and of the methods by which they may best be introduced into industrial life; and that this Committee foster the development and dissemination of the basic information concerning various fields of industrial effort, which would assist engineering students in an intelligent choice of initial employment.

5. That the U. S. Bureau of Education should be requested to continue and extend its valuable statistical survey of engineering curricula in the United States, and to collect information of the number of men who have been graduated in the several engineering courses by the combined engineering colleges of the United States for a considerable period.

In view of the many communications and suggestions which are being received which indicate a keen interest in engineering education on the part of groups concerned with various

aspects of social welfare, the Board has under consideration the possible establishment of an advisory council on engineering and social welfare, which might give attention to such matters as labor problems, personnel administration, industrial psychology, mental hygiene, city planning, public health, the social aspects of mass production, the social aspects of super-power and transportation projects, and the like. No action on this matter has yet been taken.

As soon as the details of this program have been mapped out and the coöperating committees organized the Director aims to meet with each committee for conference, as far as limits of time and distance permit.

It is the hope of the Board that a considerable body of preliminary results may be available for presentation at the Boulder convention in June.

NOTES AND NEWS.

The advisory council on engineering education established by the national engineering societies at the suggestion of this Society includes the following representatives:

From the American Society of Civil Engineers, Messrs. F. C. Shenehon of Chicago and J. Waldo Smith of New York.

From the American Society of Mechanical Engineers, Messrs. John Lyle Harrington of Kansas City and F. A. Scott of Cleveland.

From the American Institute of Electrical Engineers, Messrs. Gano Dunn and F. B. Jewett, both of New York.

From the Institute of Mining and Metallurgical Society of America, jointly, Messrs. William Kelly of Vulcan, Michigan, and Allen H. Rogers of New York.

The Board of Investigation and Coördination plans to hold a joint session with this council in the latter part of February.

Confirmation has been received of the appointment of President Frank Aydelotte of Swarthmore College and Dean Carl E. Seashore of the University of Iowa as the two additional members of the Board of Investigation and Coördination. President Aydelotte is well known to the Society as a former teacher of English, director of war aims courses in the period of the Students Army Training Corps, and an active figure in the administration of the Rhodes scholarships.

Dean Seashore is a psychologist of international reputation, now Dean of the Graduate College of the State University of Iowa, and active in the work of the National Research Council.

Unusual interest was aroused by the dinner held jointly by this Society and the American Society of Civil Engineers at Hotel Pennsylvania, New York, on the evening of January 17th. Over two hundred were in attendance, about equally

divided between educational representatives and practicing engineers. The project of the Board of Investigation and Coördination was presented by Messrs. D. C. Jackson, C. F. Scott and W. E. Wickenden. In the informal discussion which followed prominent parts were taken by Messrs. F. C. Shenehon and John Lyle Harrington, councilors of the national societies, Gen. C. H. Mitchell of the University of Toronto and Dean Marston of Iowa State College.

Similar gatherings have been arranged at the annual conventions of the A. I. E. E. and the A. I. M. M. E. in February.

The Board held a meeting in Ann Arbor on January 24th in connection with the meeting of the Division of Deans and Administrative Officers. A meeting of the Committee on Coöperation with Railroads was held in Ann Arbor on the same day. This made possible a joint dinner of the two groups, at which each outlined its problems to the other, to the great advantage of both.

S. P. E. E. MEETS NEXT JUNE IN UNUSUAL SURROUNDINGS.

The S. P. E. E. meets this year on the edge of one of the most popular playgrounds of the country. The University of Colorado is located at Boulder, a town of nearly 12,000 inhabitants, built upon the wide flare of Boulder Cañon where it breaks through the mountains and spreads out broadly into the plains. Situated thus at the foot of the Continental Divide, it commands an extensive view of the valley, and serves at the same time as a gateway to the most sublime and the most frequented region of the Northern Rocky Mountain range.

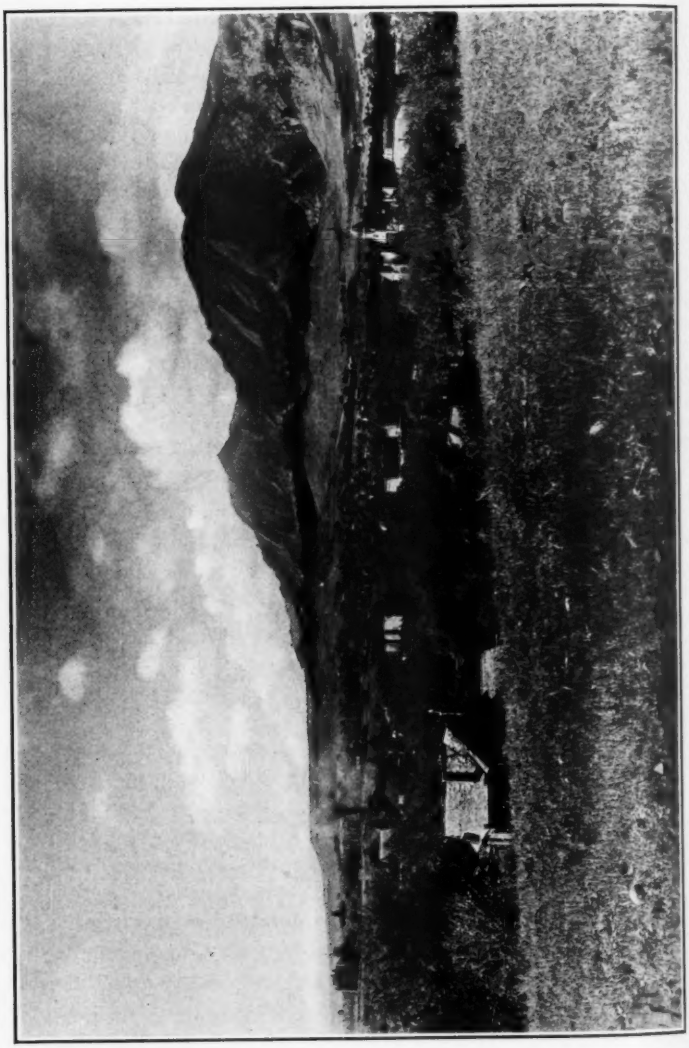
Boulder Cañon leads directly into the heart of the mountains. For eighteen miles the smooth, double-track road, in many places cut out of the solid rock of the cañon wall, winds upward until it is about 3,000 feet above Boulder, or at an altitude of 8,263 feet. The beauty of this cañon is still natural and uncommercialized. It is free to every one. At places the walls are so tall and close together that there is barely space for the road and the rushing tumbling waters of the mountain brook. Frequently, however, there are openings upon extensive vistas of pine and aspen trees along the broad side of adjacent mountains, and of snowcapped peaks in the distance.

At the upper end of the cañon, the road branches into numerous well-made roads and trails that lead into wilder and less accessible regions of the mountains and to the attractive and much frequented summer resorts. The old mining towns of Nederland, Eldora, Ward, and Central City can be reached easily by auto, the former two being at the head of the cañon. From Eldora is the main trail to the Arapahoe Peaks and to the glacier region. Northward through Ward is a splendid auto road to Allen's Park, Peaceful Valley, Long's Peak, and to Estes Park. So close is Estes Park that the longest auto

route which goes up Boulder Cañon to Nederland crosses north through the mountains into the Park, and returns to Boulder through Big Thompson Cañon, a distance of about 150 miles, most of which is slow mountain driving, requires only a single day. Shorter auto routes, though, which lead to the Park through the South or North St. Vrain Cañon, two greater gateways from Boulder to Estes Park, require only three quarters or even a half of a day for the round trip.

From Estes Park the Fall River Road, a splendid mountain highway, crosses the Continental Divide through Milner Pass, at an altitude of 11,797 feet, and descends into the Grand Lake country on the western slope. This trip can be made in one day but is more enjoyable if made in two. Perhaps the most thrilling and awe-inspiring auto trip in the Rockies is this one from Boulder to Grand Lake through Milner Pass, and then back through Berthoud Pass, about ten miles farther south. The route passes through some of the most interesting towns of the West, gives a glimpse of the vast undeveloped resources beyond the Divide, and twice winds up over the range, penetrating the most majestic scenery of the mountains.

This vast area of mountain country, open to the public, invites some form of outdoor recreation, either mild or vigorous. Great pleasure and exhilaration come from merely driving over the splendid mountain roads. If thrills without exertion are sought, they may be found by driving along the shelves that have been blasted out of the mountain side, where the wall goes straight up on the inside and straight down for nearly a thousand feet on the outside. Exciting and fascinating exercise may be had in fishing for the game mountain trout. In Boulder county alone there are 300 miles of trout streams and twenty lakes, all well stocked. For vigorous exercise, hiking is the favorite sport. Interesting round-trip excursions as short as an hour may be made into the mountains by the inexperienced hiker; but longer ones of two and three days, with the opportunity of camping out at night, are attractive to the initiated. All of the long trips, and most of the



Boulder at the Base of the Continental Divide. At the right is shown the Flatirons at the foot of Green Mountain. In the upper left hand corner is the campus of the University.

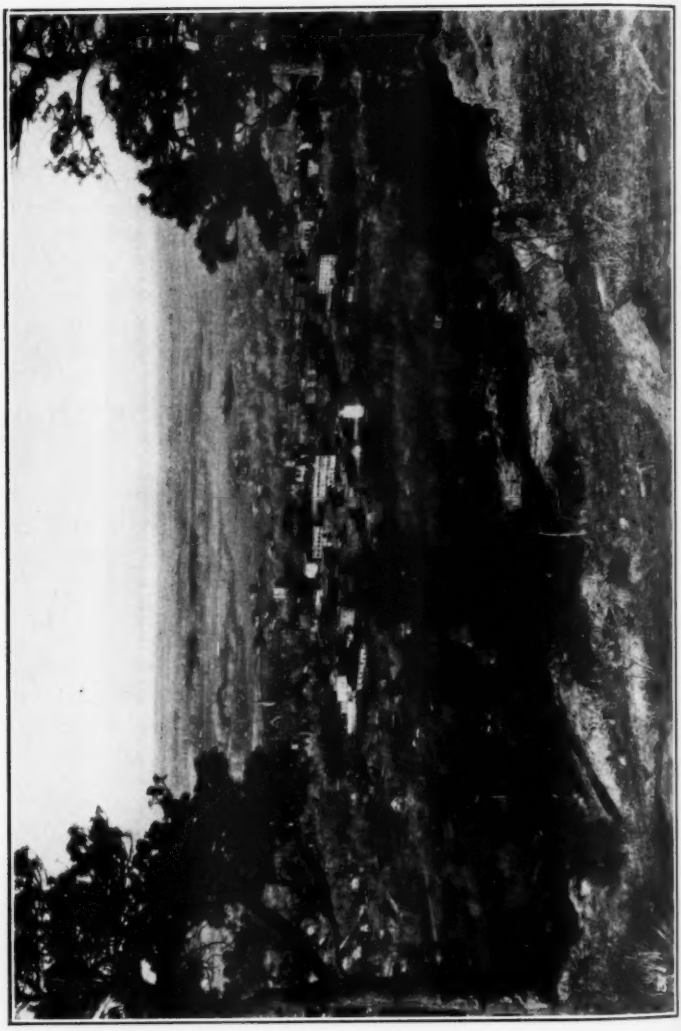
short ones, are under the direction of the hiking clubs and are in charge of experienced mountain climbers.

One of the most instructive trips is to the glacier region. Of the thirteen known glaciers in Colorado, six are in Boulder county. Among these six is the largest in the Rocky Mountains, the Arapahoe glacier, which provides the source of Boulder's water supply. The Middle St. Vrain, though, is considered the most typical. Furthermore, it is the most exposed for observation and study. It is one mile wide, 500 feet deep (the deepest of the group), and moves with a velocity of 18 feet a year. It is still advancing its own moraine, a mass of rock one and three fourths miles long, 350 feet wide, and 400 feet high. The "circ" wall at the right is 1,400 feet high. These glaciers are within one day's to three days' journey from Boulder. Most of the distance may be made by auto; but the last lap demands a strenuous climb or a horseback ride over the National forest trails.

Interesting and easy auto trips are to the old mining towns around Boulder. At the head of the Cañon is Nederland, once the center of tungsten mining, which produced more tungsten than any other point in the world. Only an hour's ride from Nederland are Black Hawk and Central City, in what was once the greatest gold mining center in the state. In their heyday, during the Civil War period, these towns had a combined population of 25,000 when Denver was a village of a few log huts. Now most of the dwellings are unoccupied and dilapidated, the substantial brick and stone hotel, theater, churches, and public buildings are practically unused, and the population has dwindled to a bare four hundred tenacious inhabitants waiting confidently a revival of the boom days in mining.

Though Boulder is not an industrial community, it can be proud of a few engineering achievements, especially in electrical development. In Boulder Cañon is a million-dollar hydro-electric plant, the water for the operation of which is taken from a reservoir at the head of Boulder Cañon, where a concrete dam forms a lake 1⅓ miles long and ½ mile wide.

Boulder at the Base of the Continental Divide. At the right is shown the Flatirons at the foot of Green Mountain. In the upper left hand portion is the campus of the University.



A View of Boulder and the Plains as Seen from Flagstaff Mountain.

The dam is 177 feet high, 624 feet long on the crest, 120 feet wide at the base, and contains 13,300 cubic yards of concrete. A remarkable feature of this plant is the unusual head of 1,830 feet. About four miles east of Boulder, the Public Service Company of Colorado, a branch of the Cities Service Company, is now constructing the largest steam electric generating plant on an artificial body of water. The initial unit is to develop 30,000 horsepower, thus making it the largest unit between the Missouri River and the Pacific coast. Of special interest, and easily accessible from Boulder, is the site of the Moffat Tunnel, now under construction, which is to be a six-mile bore through the Continental Divide. The present Moffat line should not be forgotten, either, as it is still the highest broad-gage railroad in the world.

These many and varied attractions bring thousands of visitors to Boulder each year. Last summer approximately 20,000 were in the city. Among these visitors Boulder is known as the "City Beautiful." So well do they like the place that each year some of them remain to become permanent residents. This reputation for beauty has come not only because of the well-kept appearance of the city, the beautiful homes, the splendid churches, schools, and business houses, and the 176 blocks of paving, including all of the principal streets, but also because of the 3,700 acres of adjoining mountain parks. Most of this area has been preserved in its natural state, except the portion given to the Colorado Chautauqua, located at the mouth of Bluebell Cañon and at the foot of the Flatirons of Green Mountain.

This institution, now in its twenty-sixth year, is a permanent Chautauqua, similar to the one in New York state. On its beautiful grounds are a large auditorium, a dining hall, about a hundred cottages, and several lodging houses with private rooms. Each season hundreds of people come here to live in the restful, congenial environments of this park, and at the same time enjoy the educational benefits of first-class Chautauqua programs, given daily throughout July and August.

A View of Boulder and the Plains as Seen from Flagstaff Mountain.

Though in every respect an ideal small University town, Boulder is not deprived of the advantages of a city, as it is located only thirty miles from Denver. It is on the Colorado and Southern, which runs from Billings, Montana, to Boulder, Denver, Colorado Springs, Pueblo, and other points south. Since this road is controlled and operated by the Burlington system, it makes direct connections with the main line of the latter at Denver. The Union Pacific also reaches Boulder over a branch from Brighton, Colorado. Between Boulder and Denver, the Kite Route, an interurban line, gives hourly service. Besides these facilities of travel, good roads lead to Denver and to other cities of the state. Some of these roads connect directly with the main trans-continental highways. For the accommodation of auto tourists, Boulder maintains a first-class camp. In addition to this one, though, the University plans to construct one on the Campus for the convenience of those members of the S. P. E. E. who drive to the meeting.

ENGLISH DEPARTMENT.

The Committee on English published, in the November number of ENGINEERING EDUCATION, a request for definite information regarding the status of the teaching of English in the engineering schools. The response to that request has been most generous and has put into our hands for study material that is really significant. It is particularly gratifying to receive so many letters from the deans and administrative heads of these schools. The inspiring opportunity which this rather new field of endeavor affords may not yet have been fully appreciated by the teachers of English themselves. I believe it has not. Possibly the uncertain status of the teacher of English on the engineering faculty, and the relatively lower scale of remuneration for such teachers have been partly responsible for this. Probably, too, the vision of service which has inspired some of us pioneers in this field has not yet made its general appeal. But, however this may be, certainly our deans and department heads are not insensible to the importance of the effective teaching of English as an integral part of the education of our students. The letters they have sent our committee are unmistakable evidence not only of their intelligent interest, but of their willingness to coöperate.

The Committee on English plans to prepare for discussion a syllabus based on its studies of the material made available by these letters and of other evidence accumulated by its previous efforts. This syllabus, it is hoped, will not only furnish a comprehensive survey of the present situation, as far as objectives go, but may perhaps prove suggestive to schools where the problem is only just beginning to receive recognition.

A comprehensive plan for grappling with the problem of the students' English at the earliest possible moment, and keeping in continuous and consecutive touch with it to the

end of the story would seem to include the following objectives:

1. To classify freshmen students on their entrance to college on the basis of an examination in English or on a preliminary week of test work, in such a way as to determine their fitness for college English.

2. To provide sub-freshman work for the unfit which will supplement their evidently inadequate preparation, this work to be done, of course, without credit.

3. To classify freshmen students during their first semester on the basis of achievement, with a view to demoting the disqualified and promoting to advanced work those of superior ability.

4. To require courses in English composition over a long enough period to allow the student to develop habits of accurate expression and to allow such habits to become fixed. To utilize in this work the student's special interests and predilections, but to enlarge the circle of those interests and stimulate his growth in every direction.

5. To offer a large, attractive group of elective courses in English literature, especially in modern and contemporary literature which will give the student an opportunity to follow his own desire for the thing which is likely to be for him an effective means of growth.

6. To provide some definite plan for checking the student's tendency to careless, inaccurate expression both in his oral and written work throughout his four years course, and to remand him to the English department for additional work without credit when that seems necessary.

7. To encourage in every possible way coöperation between the instructors in English and those in other subjects to secure efficiency in all student writing. This suggests the various schemes for getting the engineering instructors to note glaring defects in a student's English as well as to provide for the criticism of technical papers by the staff of the department of English.

8. To require some course or courses in English in the

senior year as a means of getting a final check on the student's English before he is graduated.

If, in anticipation of the working out in some detail of the plan thus outlined, the Committee on English can have a large number of letters of criticism or of suggestions based on experience, it will greatly increase the significance of their syllabus when it is finally drawn.

Address J. Raleigh Nelson, 927 Forest Ave., Ann Arbor, Michigan.

ONE OF THE FUNDAMENTALS.

BY EDWARD D. KINGMAN,

Wentworth Institute.

No subject, listed on the curriculums of engineering departments, has caused a greater amount of discussion at the meetings of the Society for the Promotion of Engineering Education than the subject of English for engineering students. No topic of general interest to the profession of engineering has evoked a wider divergence of opinion.

There are some members of the engineering profession who would relegate to the high schools and to the preparatory grades the teaching of English to engineering students; there are legion who adhere to the far too frequent middle course and include it in that elastic and somewhat vague classification known as "related subjects," and there are quite a number of staunch supporters who consider that English is one of the fundamentals and they believe that English should be given to engineering students in "large and frequent doses."

If English is one of the fundamental subjects of engineering training, how can it be presented effectively to students, many of whom share diverging opinions regarding its importance which are as wide apart as those of the engineering profession at large; and how can a student who is imbued with a "hatred" for this subject, or at least with an indifference, which is almost as tragic, cultivate an interest in this subject which may be comparable with the interest which he instinctively has for the technical courses of the curriculum?

Can English, which is an intangible subject in comparison with most of the technical subjects, be so presented as to fire the imagination and to arouse so high a degree of interest as that which is attained through contact with a shop, through contact with a laboratory, or through contact with the visible features of drawing and design, for which the engineering

student has distinctly marked inclination and special adaptations?

English can be presented to engineering students in such a way as to develop in them not only an appreciation of the value of language as a medium of expression, which is, obviously, an indispensable tool to well-educated engineers; but it can be so presented that it will do more than that. It can grip the imagination so that a desire is aroused, not only to learn to speak and write well, but also to maintain a vital contact with it through reading good literature, through constant library references and through discussion and debates of professional subjects. It may even stimulate that same degree of awakening expectation as that which thrills the student as he views the operation of a delicate piece of machinery, or as he participates in the derivation of an intricate mathematical theorem.

The instructors in English in technical schools have not been successful in accomplishing all this in the past. They must not expect to accomplish these ends in the future—alone. Though they may succeed in developing in engineering students a fair degree of proficiency in writing simple sentences; though they may create a momentary interest in non-technical literature, and further, though they may arouse a sincere desire on the part of the student to use correct and clear expression orally and in writing, yet every instructor in English knows that he must look to other instructors, to the instructors in the laboratories and shops, as well as those who conduct the purely technical courses, for actual assistance and not mere sympathetic coöperation, if English, that is written and spoken by engineering graduates, shall be free from the criticism that is so frequently heaped upon it.

On the technical instructors there rests a great responsibility in the matter of teaching English. On them rests the burden of exacting from every student that same degree of excellence in this subject as is expected—nay demanded—in the technical subjects. Not only must the habit for rigid accuracy be impressed on a student in the early stages of his

training in mathematical subjects, but this same habit must also be inculcated in him with respect to the use of language.

The insistence by an instructor on the need of accuracy in technical subjects has become a fetich before which every student renders faithful obeisance and woe to him who evades his duty. In the use of English, accuracy is no less important and in this subject, no less than in the technical subjects of mathematics, mechanics, design and others, the student should not be permitted to depart from the high standards established by the departments of English.

Much, far too much of the value of the instruction in English, is lost to students because of the prevalence of contradictory standards of use on the part of instructors in other than the departments of English. The use of condensed texts; the use of abridged forms for laboratory notes and the acceptance of brief and close-clipped expositions in oral recitations—all these are impediments which the instructor in English strives to overcome. They are very serious hindrances to real progress in developing an easy, fluent expression on the part of the student.

Thus it happens that the efforts in behalf of efficient English, while not wasted, at least are somewhat handicapped because many instructors, if they do not actually imply an indifference toward the instruction of English, nevertheless do not exhibit a keen appreciation of the responsibility that rests upon them for maintaining as high a standard in this subject as that which they strive for in the particular courses with which they are affiliated.

It is taken for granted that every instructor in engineering should be well grounded in the fundamentals of engineering. It is not enough that an instructor in shop methods or in design shall know only those particular methods by which various speeds are calculated or the amount and kind of stress in a particular member of a truss shall be computed. Nor is it sufficient that he shall consider that his sum total in class instruction shall consist of an ability to operate a machine or demonstrate a theorem. He must be able to create a vision

in the student's mind. He must regard it as his duty to see that the student is capable of giving expression regarding this vision in clear and fluent terms of the English language. He must show him how to do this if need be and accordingly his own proficiency in English is a matter of grave concern. Its use carries with it a deadly responsibility.

In connection with this view of the writer concerning the responsibility for effective instruction in English, the requisites which are essential for instructors in engineering might well be considered.

It is not sufficient that an instructor in technical subjects shall be well grounded in engineering science—"and even in English," as one contributor has naïvely suggested. He must be proficient in each of the fundamentals and these are English first, mathematics second, and physics third.

A fallacious idea, common to students and instructors alike in engineering schools, is that a technical training produces keener and more sensitive perceptions and accordingly, through the agency of an engineering training, one is more likely to be equipped with faculties for better solving the various problems which confront mankind. Such a misapprehension reflects unfavorably on the effectiveness of the instruction in English. It tends to belittle the value of historical and romantic associations which are so intimate a part of engineering science and without which there can be no enduring enthusiasm to kindle the imagination.

The mind of the classicist may more readily reflect the thoughts and more easily find expression for them in unencumbered terms. On the other hand, the technically trained mind may more easily create an image; it may evolve a complete mental delineation, but it is true that his expression of his ideas in language is generally restricted. His terms are mechanistic and frequently inadequate for transforming abstract ideas into concrete form.

The well-educated engineer should possess not only the flexibility of mind that is associated with the classicist, but he should have that precision in thought which is attributed to

technical training. He should possess both the faculty for creating and the faculty for expressing his creation.

It is through the medium of the comprehensive course in English, as well as through the medium of technical courses, that an engineering student may attain that degree of excellence that is urgent in the profession at large. The impetus toward the achievement of a high standard must necessarily be given in the departments of English, but the awakened interest must be nourished in a large part by instructors in technical subjects. To them must be looked for the greater share in promulgating and expanding ideas into clear and fluent expression by the student. In the shop, the working of metal might well be a full chapter of the history of art and industry in metal; it should be more than the operation of a particular machine. In the laboratory, the confirmation of chemical reactions should awaken in the student a zeal to learn more of the struggle of man to master the secrets of the elements. The project in the drawing room, in a similar way, should enthuse a student to that extent that he feels that he must continue a vital contact with it in the library, in the technical societies and even in conversations with his instructor and with his fellow students.

It is the duty of every instructor to generate in the student an absorbing interest in the subjects of a curriculum; it is also his duty to "lead" the way and "draw out" through the agency of good English the visions which a student has conceived. This is the meaning of education. Its most valuable tool is language.

With technical instructors doing their part in the development of a high standard in English, the instructors in the departments of English need no more stand like Jeremiah of old and exclaim aloud in the wilderness of Judah, "Oh that my words were now written." "Oh that they had been printed in a book."

SMALL VERSUS LARGE PLANTS FOR THE ENGINEERING GRADUATE.

BY W. ROLAND NEEDHAM,

37 Gartmore Gardens, Goodmayes, Essex, England.

Parents and guardians—particularly if they themselves have had no actual working experience as a backing to aid their choice—are often in doubt whether a large or a small engineering concern is the better training ground for a youth. When a boy is thrown largely upon his own resources, too, he is frequently at a loss to know where lies the greater inducement and which offers the brighter prospects.

These short notes are intended to help those in uncertainty. Such, however, must not expect anything in the nature of a pontifical pronouncement—at any rate from the present writer. He will try to place pros and cons as clearly as he knows how and to the best of his knowledge. It is then up to those interested to make their own choice.

The thing above all to remember, in the first place, is that it is not to a machine, but to a *person*, one is catering. This is the veriest truism, and surely the most trite of all remarks. It is often necessary, however, to emphasize, and emphasize most strongly, things which should be quite obvious. This is in fact a case in point. It not infrequently happens that otherwise conscientious and kindly parents are yet woefully ignorant of the real trend of their children's interests and capabilities. Only those who take the trouble to revisit the world wherein the child and the adolescent live can expect to interpret the hopes or understand the ambitions of growing boys and girls. It is the human father who's the real pal to his lads, who can be expected to know something of what they are made of and cut out for. Such a dad is an acquisition indeed to his son. He can tell at least what the lad is keen upon and what is the boy's "bête noir." Even if a youngster

shows no marked preferences at all, beyond the zest for sport and the movies, his father's interest in him is seldom wasted. Sooner or later the dormant tastes and the zest of congenial labor will be awakened into activity. There is nothing a man welcomes more than the revelation of this metamorphosis in his son's character. It amply repays him for much apparently unproductive effort.

At the same time parents do well to recognize their own limitations. Unless a son inherits his father's tastes and predilections, it is most likely the father will have at best but an amateur's knowledge of whatever pursuits the lad favors. Thus, should the boy evince interest in some particular direction, it is not likely the parent will be able to adjudge impartially the boy's prospects or his ability to carry on. It is always a good plan to seek the advice of some qualified person who can appreciate and rightly appraise what he sees in the boy, and who has opportunity for seeing what he is asked to pronounce judgment upon.

The foregoing is stressed because it is of the utmost consequence. A lad is young once. To a far larger extent than is commonly conceded, the choice those make for him who are his sponsors will determine the character of the life he shall lead. They not only choose the *manner* of his life work, they largely influence the *temper* with which he shall carry forward. It is very much a question of *morale*. Whether the work is congenial to him, merely passible, or absolutely repulsive, may mean mostly everything. Where a boy is keen as mustard upon his job, that boy is happy. The boy who is bored by his work cannot be expected to enthuse overmuch. Many a man professes to make the best out of a poor thing; but his fellows only agree that it is a poor best. If the boy or man is condemned to a task which is positively repellant, however, he should forthwith, if at all possible, seek pastures new. So long as his complaint is not a general distaste for all work, this is the sanest course to take.

These observations, of general applicability, concern those also who embark upon an engineering career. Indeed they

are in this connection most apposite. There is no finer vocation than that of the engineer. The only proviso is that by disposition and inclination the man be cut out for the work.

Having decided that a boy shall become an engineer, it is often of very considerable importance that one should choose discriminately the field wherever issue shall be joined. In many cases, of course, local conditions are a determining factor. Influence, too, often weighs heavily in the scale. Where, however, neither of these causes operates, the range of choice is a much wider one. It is then most important that one should be in good case to recognize that there are certain pros and cons, and particularly to be able to weigh them carefully and with understanding.

A large, up-to-date concern has unquestionably much to recommend it. Certainly no engineer's education is complete who has never at least drawn part of his experience from such a source. Whether the big works, however, is the ideal training ground for the average engineer is more open to discussion. Such a concern may reasonably be expected to be up-to-date in its machinery and equipment, and to possess the advantages of a carefully planned, well-executed system and routine of service. Labor-saving, production-stimulating devices should be to the fore. In fact, so well equipped will the various departments be, so well-served by tractor, crane, or hoist, that for the first years of his career the youth may see too much of the machine, and this may tend to blind him to the full significance of the part a *live* man may take in it all.

Unless a youth be super-observant, and also more than ordinarily *quick in the uptake,* most of the elaboration and perfection in design, purpose, and functioning will be to him as Greek to the non-classical student. The ability to appreciate the various refinements usually comes with the familiarity which only time and intelligent observation can produce. Now in the large, well-organized shops the tendency is probably, almost of necessity, towards specialization so far as the operatives are concerned. Any man who exhibits a marked

aptitude for a particular class of work is for the most part kept to that work. He becomes adept in a certain sequence of movements, achieving an automatic, clockwork kind of precision. This proficiency is at a maximum when applied to a particular machine or batch of machines. He becomes almost part and parcel of the mechanisms he operates; and he can manipulate the whole tool with a sureness and delicacy which is kin to the musician's or the surgeon's touch. He can get out of the machine what no other man can compass. Not unnaturally he is kept harnessed there. Nor is this state of affairs confined to the so-called productive departments. It operates to scarcely a less extent, in many instances, so far as clerical, design, and drawing staffs are concerned. By an almost inevitable law of selection, men are set apart for certain strictly limited classes of work. In fact it not infrequently happens that a man handicaps himself by reason of his very expertness in one particular direction. His handicap has on occasion withheld him from well-deserved promotion. Thus a chief has been known to say: "Brown would be just the man for the job, but he is much too useful where he is; let Smith take it over." In the large works, good work of a very high order of excellence is done; methods and processes are efficient and admirable; but in practice, the worker himself, whether it be manual or brain work he does, is in the main restricted to a rather narrow range of experience, first rate and front rank though it be.

On the other hand, in many small concerns, the plant, equipment, tools, and services are often less efficient, and they date back further than many ladies (by repute) care to remember or at least acknowledge. The organization is less thorough and not so fool-proof. From the point of view of the grown engineer, as compared with the large modern shop, the ordinary small works has many and marked drawbacks. At the same time, there are certain compensations which should appeal specially to the beginner. Under such auspices, in the majority of cases, there is more scope and wider breathing space; there is elbow room, and opportunity for individ-

uality to express itself. A boy is thrown more upon his resources; he is less spoon-fed. Things are more diverse, sequences of operation more palpable. The lad of parts who is keen and alert can pick up his information with comparative ease. The work he is called upon to do covers a much wider range, though the tools he operates may leave something to be desired. The very improvisations which necessity compels are all part of an education which turns out the *real man*, self-reliant, resourceful, and competent. He may and probably does lack the local, one-directional proficiency which the large shop experience engenders. That, however, and the knowledge of the greater range and intricacy of operation follow upon his change over to the large, well-equipped works. Then it is that his vital grasp of the simpler mechanisms and less elaborate processes will stand him in good stead. He is in the position of one well grounded in first principles who can accordingly proceed to interpret and apply matters varied and complex. What would otherwise have been absolutely alien is readily understandable. The boy who has been encouraged to think out processes has been gaining a most valuable education. The encouragement often comes by way of the conditions obtaining in a small shop, and the small shop is more frequently than not an admirable training ground for the young idea.

In conclusion, the writer considers that in the majority of cases, and for the majority of youths, the better initial experience is to be gained in a small rather than a large concern. It is to be remembered, too, that many modest undertakings are yet quite up-to-date in plant, tools, and methods of production. A boy has oftener than otherwise a more varied scope. He is called upon to tackle a large variety of work. This provides him with excellent opportunities for making good in more ways than one. While most of his success depends upon himself, success may be reached by several avenues instead of by one or two only. Above all, that training is to be recommended which puts a lad upon his mettle and affords him scope for self-expression.

The ambitious young man will of course seek to round off and perfect his attainments by intimacy with the most modern and perfect of machinery and method. After his apprenticeship period is over, he will doubtless transfer his services from the small to the large shop. He certainly would be very well advised to do so, even if afterwards opportunity to make good leads him in a leading capacity back again to the small concern.

So long as those for whom the advice is meant do not take it as being necessarily true for every condition, irrespective of circumstances which may be exceptional, the advice should be timely. The writer trusts it may be of some use.

AN APPEAL TO THE MEMBERS.

NATIONAL SOUTHEASTERN UNIVERSITY, NANKING, CHINA.

January 2, 1924.

DEAN F. L. BISHOP, *Secretary,*

Dear Sir: Only a few months ago, we secured, through your kindness, a complete set of the Proceedings of the Society together with a large collection of the ENGINEERING EDUCATION magazine. We had not had enough time to go over these volumes when, on December 12, a disastrous fire destroyed one of our University Buildings that contained the Engineering Reference Library. We have suffered much loss from the fire, as all of our surveying instruments and books were destroyed in the flame, but among those which we value most highly are the set of the *Proceedings* of the Society and the back numbers of ENGINEERING EDUCATION magazine. At normal times we would, of course, try to replace them at any cost, but when confronted with an unusual circumstance, such as we are in now, the financial condition will not allow of any purchase beyond meeting immediate needs arising from the loss. I am, therefore, writing this letter to inquire if there is any possibility for us to secure a set of the *Proceedings* at less than normal cost. For the cause of elevating Engineering Education in China, may we not cherish the hope that some members of the Society will make us gifts with their own collections as to leave perpetual memory in China. We shall appreciate your kindness in making a note of this appeal in the Society *Bulletin.*

THOMSON E. MAO,
Dean.

Editor's Note: Please send all contributions to the office of the Secretary (Dean F. L. Bishop, University of Pittsburgh, Pittsburgh, Pa.) and they will be packed in one box and shipped to Dean Mao. The box will be held open until April 15.

SECTIONS AND BRANCHES.

Case School of Applied Science branch held its first meeting of the college year 1923–24 on Tuesday, January 8, 1924. The members met for a cafeteria supper at the Case Club at 5.45 P.M. Twenty-five members were present when Professor K. O. Thompson, president of the branch, called the meeting to order at 6.40 P.M.

After the minutes of the previous meeting had been read and approved the following topic was presented for discussion: "The National Engineering Societies and the College Student." Professors H. M. Boylston and R. N. Danforth opened the discussion with the sub-topics, "Local Sections and Student Societies as Media for Establishing Closer Relations between the National Engineering Societies and the Engineering College Student," and "The Work of a Liaison Committee of a National Engineering Society." A lively discussion followed.

ANTHONY JENKINS,
Secretary.

The Minnesota Section held its second meeting of the school year on January 16, 1924, in Room 201 of the Minnesota Union. Forty-eight members and guests gathered for a 5:45 o'clock dinner.

Professor F. B. Rowley, President of the Section, presided.

The principal speech of the evening was given by D. G. Patterson, Associate Professor of Psychology, on the subject of "Improving the Examining Function in Teaching." Professor Patterson discussed the subject from the standpoints of

1. Discursive answer questions,
2. Completing statements,
3. Marking true and false statements,

4. Recognition or choice of correct answer,
5. Recall or one-word answer.

The speech of the evening was followed with a discussion by Dean Leland, Dean Dowrie, Professor D. G. Patterson, Professor Frederic Bass, Professor G. D. Shepardson, Professor E. A. Stewart, Professor C. A. Mann, Professor R. E. Kirk, Mr. John Flodin and Mr. Walter R. Warne.

The meeting adjourned at 8:45 o'clock.

H. B. WILCOX,
Secretary.

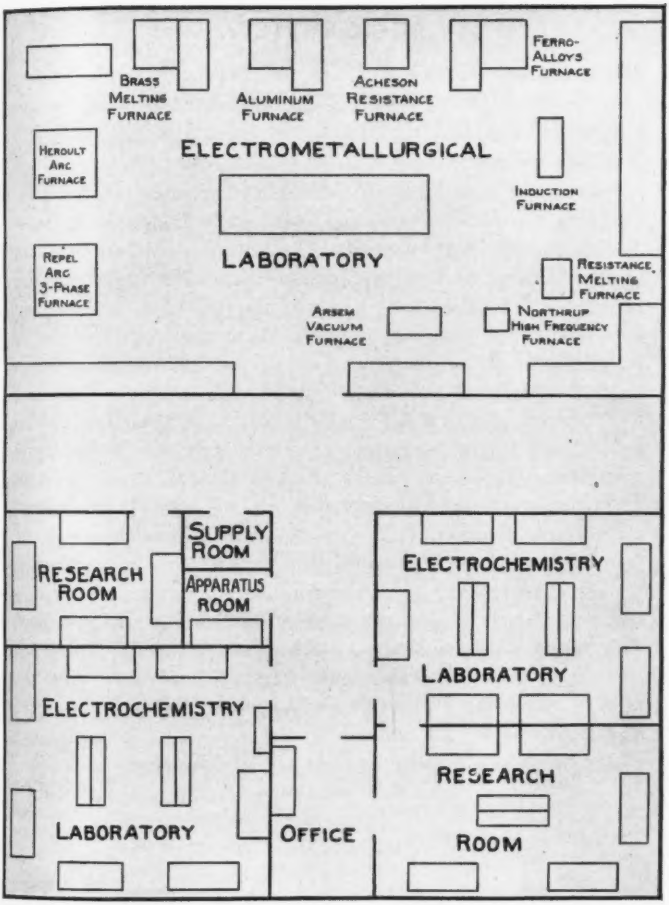
COLLEGE NOTES.

Rensselaer Polytechnic Institute.—The addition to the Electrical Laboratory, to be finished in April, contains a floor for Electrochemical and Electrometallurgical work. This is distinct from the Chemical Engineering Laboratory. The plan shows the arrangement of rooms and also shows some of the apparatus to be installed.

At the last meeting of the Board of Trustees ten new fellowships for graduate students were established, the value of each being $750 a year. These fellowships are for graduate students of a high class, in Civil, Mechanical, Electrical or Chemical Engineering, studying for the Master's or Doctor's degree.

A new building is to be erected in the spring for the Department of Civil Engineering. This building will contain the various laboratories for testing materials of engineering, including a cement-testing laboratory and a laboratory for testing road materials, beside the necessary lecture, recitation and drawings rooms.

Installations are still being made in the laboratory of the Department of Chemistry. There have been installed lately an air dryer, a gas absorption tower of unusual design, a nitrating kettle, a soap kettle, and a vacuum still for high temperature distillation. All these are of commercial size and have the accessory apparatus.


BRASS MELTING FURNACE
ALUMINUM FURNACE
ACHESON RESISTANCE FURNACE
FERRO-ALLOYS FURNACE
ELECTROMETALLURGICAL LABORATORY
HEROULT ARC FURNACE
INDUCTION FURNACE
REPEL ARC 3-PHASE FURNACE
RESISTANCE MELTING FURNACE
ARSEM VACUUM FURNACE
NORTHRUP HIGH FREQUENCY FURNACE
SUPPLY ROOM
RESEARCH ROOM
APPARATUS ROOM
ELECTROCHEMISTRY LABORATORY
ELECTROCHEMISTRY LABORATORY
OFFICE
RESEARCH ROOM

BOOK REVIEW.

Mechanics via the Calculus. P. W. Norris, Alleyn's School, Dulwich and W. S. Logge, The Polytechnic, London. Longmans, Green and Co., 1923. Cloth, 5½ x 8½, xi + 340 pages, $3.75.

Here, true to the title, the Calculus has come into its own, enabling the authors to present in every instance the most direct, concise, comprehensive, the comprehensible discussion of both theory and examples. There are 169 diagrams and more than 700 problems. Answers are provided. The fifteen chapters cover practically every topic and problem to be found in the standard treatise on mechanics, and in addition a great number of important but more difficult problems not to be found in any other single text. More than 150 fundamental and typical examples are completely solved and fully discussed. The first two chapters deal with linear motion. Then follow chapters on motion in a plane, centers of gravity, attractions, friction, virtual work, equilibrium, moments of inertia, kinetic energy, equilibrium of strings, the action of forces, conservation of momentum and of energy, hydrostatics, central orbits, elasticity, and stresses and strains in beams. The theory of dimensions is well although briefly presented. Reference is made to the recent investigations concerning the laws of attraction. The volume has great value as a reference and source book. Its mastery would make all subsequent use of the calculus a natural and easy mental process.

K. D. S.